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The Airliner Cabin Environment

AIR QUALITY AND SAFETY

Committee on Airliner Cabin Air Quality
Board on Environmental Studies and Toxicology
Commission on Life Sciences
National Research Council

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PREFACE

This study came about because a series of Congressional hearings in 1983 and 1984 revealed that the available data on airliner cabin air quality were contradictory. Concern was expressed about the absence of standards for many aspects of cabin air quality that annoyed passengers and crew. The regulatory community and the airline industry asserted that present standards and practices were adequate and that the aircraft environment endangered the health and safety of neither passengers nor crew.

As a result of the hearings, Congress, in Public Law 98-466, mandated that the National Academy of Sciences conduct a study to determine whether air quality and standards aboard commercial aircraft are adequate for the health and safety of all who fly. The Academy was asked to determine whether such aspects of cabin air as the quantity of outside air, the quality of onboard air, the extent of pressurization, the characteristics of humidification, the presence of cosmic radiation, contaminants (such as bacteria, fungi, and other microorganisms), and pollutants (such as environmental tobacco smoke, carbon monoxide, carbon dioxide, and ozone) could be responsible for health problems in the long or short run; to recommend remedies for problems discovered; and to outline the safety precautions necessary to protect passengers in event of in-flight fires, which produce smoke and fumes. Accordingly, the Committee on Airliner Cabin Air Quality was established in the National Research Council's Commission on Life Sciences.

Issues the Committee addressed included the following: Are there problems with the air quality in commercial airliners? If so, what is the potential public health significance for those exposed over the

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short or long term? Are the problems solely those of brief discomfort, or are the health and safety of crew and passengers threatened? How well established is the threat? What can be done to alleviate it?

The Committee has reviewed the available pertinent information to reach an independent scientific consensus on these issues. Unfortunately, evidence on these questions is sparse, especially on health effects. Carefully designed epidemiologic studies of health effects associated with air travel are virtually nonexistent, and most of the relevant published reports deal only with specific incidents. Hence, it is difficult to evaluate the risk to the exposed population. Indeed, the dearth of pertinent data limits conclusions about the potential for adverse health effects to no more than estimates. Much more research must be conducted before risks can be accurately assessed.

The words "health" and "safety" are emphasized throughout. The Committee found it difficult to pigeonhole problems neatly as related to health, safety, comfort, or combinations of these. For example, the time required to evacuate a plane if fire occurs is certainly a safety issue, but it is also a health matter, in that evacuees will be subject to toxic fumes for a longer or shorter time. Cigarette smoking might be primarily a comfort issue for both nonsmokers exposed to smoke and smokers deprived of their stimulant; it might also be a health issue for nonsmokers, as well as smokers; it is certainly a safety issue if cigarettes are improperly disposed.

The importance of these distinctions is that the Federal Aviation Administration (FAA), for which this study was prepared, might not have the statutory authority to deal with some issues the Committee identifies. Distributed authority for the management of a situation is not unusual. For example, whether a radiation hazard is managed under the mandates of the Environmental Protection Agency, the Department of Transportation, or the Nuclear Regulatory Commission will depend on whether the radiation source is in a nuclear-energy producing facility, is in transit, or is being disposed of.

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As scientists and engineers, we cannot determine whether FAA alone can address the questions we raise, nor can we easily say whether they are questions of health, safety, or comfort. The legislative branch (if law must be clarified or written) and the executive branch (if, for example, coordination among agencies is required) must sort out responsibilities in appropriate ways.

The Committee has gathered for the first time much important information about a complex environment. As a result of the study, we make one recommendation that clearly will be controversial. It is unanimously and forcefully proposing that smoking be banned on all commercial flights within the United States. The reasons are presented and elaborated in the text and executive summary, but the process by which the decision was reached belongs here.

First, it should be emphasized that the makeup of the Committee was diverse, and only three of the 11 members were physicians with experience in the care of patients crippled or dying as a result of cigarette-smoking. Most of the members are ex-smokers who are admittedly annoyed by cigarette smoke in airliner cabins, as well as other public environments. However, most began the study with the assumption that addicted smokers could not be deprived of their habit over long flights, and therefore smoking could not be prohibited, especially on longer flights. Development of support for a complete ban was gradual, as the evidence of contamination and the impossibility of adequate cleansing of the cabin air became more and more apparent. The coup de grace to smoking in airliners was the realization that diminished ventilation with outside air and increased recirculation of air, a characteristic of almost all new airliner models, will increase previous levels of toxic products of cigarette-smoking in nonsmoking sections of the cabin. When smoking is permitted, the result of these changes places cabin air ventilation in violation of the building codes for most other indoor environments.

We recognize that prohibition of smoking on airplanes will cause discomfort and annoyance among inveterate smokers and the tobacco industry, but it is also likely to be supported by the majority of the flying public and cabin crew members. We hope that the controversies

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likely to arise regarding this recommendation will not divert deserved attention from the other notable proposals of the report, especially the call for much more research on other aspects of cabin air quality.

To conduct its study, the Committee reviewed the available scientific and technical literature, including characteristics of various models of modern aircraft. It conducted a series of technical meetings and briefings with experts in relevant fields. In addition, members made a number of site visits to evaluate specific aspects of the issues before the Committee. The sites included: National Airport, to examine the cabin air circulation machinery of a TWA MD-80; the FAA Technical Center in New Jersey, to review procedures for testing flammability of cabin materials; the United Airlines flight attendant training Center in Chicago, to gather information about emergency training procedures; and the Boeing Commercial Airplane Company in Seattle, to explore developments in aircraft design. We are grateful to all those who educated and informed us during these visits. The Committee also thanks FAA for its support in supplying the information and assistance we requested. The Committee is unanimous in its praise of National Research Council staff, who worked prodigiously to make our job easier and more effective. Equally important, I thank the Committee members for their hard work in individually reviewing data and writing the text and for their good humor and substantive contributions to our many meetings.

Thomas C. Chalmers, Chairman
Committee on Airliner Cabin Air Quality

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Flight attendants have direct experience with airliner cabin environments, and they helped focus attention on issues of air quality, health, and safety. We express our special thanks to Margaret Brennan and Lynne Egge, representing the Joint Council of Flight Attendant Unions, to flight attendants Phyllis W. Conrad, Nancy Garcia, Janna F. Harkrider, Lana Holmes, and Betsy Murtaugh; and to all flight attendants who wrote letters to the Committee.

The Committee visited several facilities to obtain information and observe operations and practices. We wish to thank David J. Shearer, supervisor of airport services for TWA at National Airport, for explaining the ventilation system of an MD-80 aircraft; Constantine P. (Gus) Sarkos and the technical staff at the FAA Technical Center in Atlantic City, for demonstrations of fire testing procedures and full-scale simulation tests; United Airlines personnel Paul Smith, emergency procedures training manager, Janice Northcott, inflight

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The Committee consulted with a number of experts about various topics. We would like to thank John C. Bailar, William Cain, Frederick B. Clarke, III, Arthur B. DuBois, and Ralph Goldman for their contributions. The Committee gives special thanks to Barry Ryan of Harvard University for developing the mathematical model used in this report.

An open meeting was held to receive comments from the public. We are indebted to Senator Daniel K. Inouye for giving the keynote address. Several people made presentations at the meeting; they are included in the list below.

The Committee thanks all the peer reviewers of the report. Their constructive remarks contributed to the improvement of presentations of technical information and its readability.

So many other individuals and organizations assisted the Committee in various ways that it is difficult to mention them all. Nevertheless, with apologies for whatever inadvertent omissions occur, we shall try:

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